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September 8, 1958

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Dear Sir:

This letter report describes the activity under Task Order No. C during July and August, 1958.

During this period, bench-scale tests were run using water taken from a local private lake 25X1 to check out the effect of this type of water on the total generation time; also, two 1/10-scale runs were conducted in the small experimental generator at the private lake. Experiments were performed with the full-scale experimental generator, to acquire experience and to develop a technique for handling and filling (with water) the unit. Subsequently, a full-scale run in the large experimental unit was conducted.

Bench-Scale Tests

In preparation for the full-scale run to be made at a private lake, experiments were conducted in order to provide a basis for comparison of the generation rates obtained using the private-lake water and 25X1 water; the latter had been used in all of the runs in the small experimental generator.

The apparatus consisted essentially of a Mason jar with a dropping funnel and a thermocouple inserted through the jar top.

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The jar was large enough to hold 200 cc of the water being tested and the appropriate amounts of sodium borohydride and cobalt chloride solution. The dropping funnel facilitated the addition of the catalyst solution, and the thermocouple was used to measure the temperature of the generation reaction. The evolved hydrogen was bubbled through water and then exhausted through a hood. The end of the reaction was judged as the time when gas bubbles were no longer visible in the solution within the jar.

The results of the tests on [redacted] and also the private-lake waters are as follows: 25X1

Type of Water	Time for Completion of Reaction, min.	Temperature Rise During Reaction, F
[redacted]	22	30
Private lake	19	37

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On the basis of these data, it appears that the use of the private-lake water should present no particular problems in connection with the hydrogen generation.

1/10-Scale Runs

Two 1/10-scale runs were made at the private lake in the small experimental generator, in order to check out the scaling factor involved when this particular type of water was used. The data obtained are presented on the following page:

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Run No.	Temperature, F Initial	Rise	Amount of Catalyst, lb	Total Generation Time, min
18*	85	23	0.91	30
19**	84	33	0.78	37

*The amount of water used was not measured.

**55 gallons of water were used.

In Run 18, the water was added to the generator unit by immersing the unit in the lake to a predetermined depth and allowing the water to flow in spontaneously; thus, the amount of water used in the reaction was known only approximately. However, the data obtained indicate that this type of water can be used without changing the relative amounts of the borohydride and catalyst needed.

Handling and Filling of Large Generator

Effort was expended in exploring the optimum ways of handling and filling the full-scale generator. A procedure was developed for handling and filling the unit effectively and conveniently; to facilitate the spontaneous-filling operation, a 15-pound weight was attached to the bottom of the unit. The filling-rate data obtained using this procedure are indicated below:

Spontaneous-Filling Time, min	Amount of Water Entering Large Generator, gal
30	305
40	495
50	565
60	585

Subsequent filling experiments were conducted at the private lake using an estimated weight of 15 pounds, in order to explore the effect of a slight variation in the attached weight such as might occur under field conditions. The resulting data are as follows:

Spontaneous-Filling Time, min	Amount of Water Entering Large Generator, gal
53	560
60	605
120	610

The results of these filling tests indicated that, in 50 to 55 minutes, the appropriate amount of water (560 gallons) spontaneously flowed into the full-scale generator with a weight of approximately 15 pounds attached to the bottom.

Full-Scale Test

On August 5, a full-scale run was made at the private lake. With a few minor exceptions, this experiment was conducted using a closely simulated field-operation procedure. Motion pictures were taken of the entire operation, and the film was provided to you for processing and subsequent study. The operating procedure used was detailed in our letter of August 21, 1958.

The full-scale unit operated successfully; it filled spontaneously with the appropriate amount of water in about 50 minutes and the time required for complete evolution of the gas

was about 26 minutes. Since the makeshift attachment from the generator to the balloon inlet tube did not function properly, no figure for the total volume of hydrogen generated is available. In this run, 100 pounds of sodium borohydride and 8.6 pounds of $CoCl_2 \cdot 6H_2O$ were used.

As discussed in our letter of August 21, it is recommended that consideration be given to the development of a positive balloon-to-generator attachment. Also, if the service requirements for this unit permit, there is probably merit in adjusting the amount of catalyst solution added, in order to decrease slightly the rate of hydrogen evolution. It should be mentioned that, if possible, another full-scale test should be performed at the lower end of the anticipated ambient-temperature range, in order to check out the operation of the unit under cold-weather conditions.

In addition, work was initiated on the preparation of a report summarizing the research conducted under this Task Order. In this connection, and in accord with our discussion on August 5, a proposal dated August 15 was prepared and submitted to you that concerned the formulation of a recommended operating procedure for the full-scale hydrogen generator and the inclusion of a description of this procedure as a section of the summary report.

The total appropriation on this Task Order was $44,143.

As of August 1, 1958, the unexpended balance was approximately $2,000.

Sincerely,

[redacted]

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[redacted]

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In Duplicate

9/10/58